



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

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San Francisco, Ca. 94105

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May 30, 1991

Memorandum

Subject: Navajo Bluewater Site - Preliminary Risk Assessment

From: Sharon Seidel, Ph.D.  
Region IX Toxicologist (H-8-4)

A handwritten signature in cursive script, appearing to read "Sharon Seidel", is written over the typed name and title.

To: Robert Bornstein  
On-Scene Coordinator (H-8-3)

I reviewed the EPA ERS Preliminary Assessment Data for the Bluewater uranium mine site. Human health risks for both the Brown-Vanderver and the Desiderio areas exceed  $10^{-4}$  for a 2 year exposure period. The exposure pathways for which risks were quantified include external gamma exposure and ingestion of soil contaminated with radionuclides. Additionally, risks from inhalation exposure to radon/radon decay products from the mine tailings have been estimated to occur in the  $10^{-4}$  risk range over a 2-year exposure period, for an individual 100 meters downwind from the source. Risk calculations and exposure assumptions are summarized on the following pages of this memo. Risks are also provided for a 5-year exposure period - assuming the interval between site discovery and site listing/interim remedial action exceeds 2 years, and for a 50-70 year exposure period - assuming the site is not listed on the NPL and no remedial action occurs.

Additional pathways of concern at this site include (1) fugitive dust exposure from the mine wastes, (2) exposure to ephemeral surface waters pooling on-site (through external contact (swimming or wading) and casual ingestion), (3) ingestion of contaminated food, (4) exposure to radon in homes, (5) exposure to radionuclides from contaminated soil particulates adhering to sheep wool as it is handled during preparation for weaving, and (6) exposure to tailing material which may have been intentionally or unintentionally moved to the vicinity of the homes, subsequently becoming a near-field attractive hazard, particularly for children.

While external gamma exposure, radon flux and ingestion of contaminated soils from the mine piles may reasonably be expected to be reduced by the proposed ERS action of covering the piles, exposures which may not be reduced potentially include pathways 3 - 6, and conceivably pathway 2 (via contaminant leaching through the soil cover). Further site investigation is recommended to address these potential pathways, including (a) sampling of surface waters for radionuclides and heavy metals, (b) analysis of sheep and other locally grown food for radionuclide contamination, (c) an extension of the limited radon surveying done to date in homes, (d) analysis for radionuclide contamination of wool and woven products produced on site, and (e) a near-field gamma survey.

## Navajo Bluewater site

### General exposure assumptions

**RME** - Risk calculations were developed using the Reasonable Maximum Exposure (RME) approach outlined in the EPA *Risk Assessment Guidance for Superfund* (RAGS, 1989). The RME characteristically adopts the upper 95% confidence limit on the arithmetic mean of site data. 95% UCLs used in the exposure calculations are as follows:

External gamma - Brown Vanderver site:		425 $\mu$ rem/hr
External gamma - Desiderio site:		197 $\mu$ rem/hr
Soil radionuclides - Brown Vanderver site:	Ra-226	399 pCi/g
	U-233/4	330 pCi/g
	U-235	24 pCi/g
	U-238	367 pCi/g
Soil radionuclides - Desiderio site <sup>1</sup> :	Ra-226	34 pCi/g
	U-233/4	17 pCi/g
	U-235	0.7 pCi/g
	U-238	17 pCi/g

<sup>1</sup> Soil values for the Desiderio site represent the maximum detects rather than the 95% UCL, since the latter exceeded the sample maxima for all radionuclides.

### External Gamma Exposures

Eqn:  $\text{Gamma (mrem/hr)}^a \times 10^{-3} \text{ rem/mrem} \times \text{EF} \times \text{ED} \times 6.2\text{E-4 risk/rem}^b = \text{risk}$

<sup>a</sup> 95% UCLs on readings at the B-V or D sites

EF = Exposure Frequency (hr/day x days/yr)

ED = Exposure Duration (years)

<sup>b</sup> Cancer incidence Ref: EPA *Risk Assessment Environmental Impact Statement NESHAPS For Radionuclides Background Information Document Vol. 1, Table 6-7* (EPA 520/1-89/005)

### External gamma exposure scenarios -

Shepherd herding sheep on site: EF = 4 hr/day x 300 d/yr  
ED = 2, 5 and 50 years

Child playing on site: EF = 2 hr/day x 365 d/yr  
ED = 2 and 5 years

Comment - Exposure periods are based on time-use data provided by the Navajo Superfund Office (Window Rock, Navajo Nation, AZ) and reasonable maximum exposure assumptions regarding time spent in the vicinity of the tailings.

## Navajo Bluewater site

### Gamma Exposure Risks

	2 years	5 years	50 years
B-V Sheepherder	6E-4	2E-3	2E-2
B-V Child	4E-4	1E-3	na
D Sheepherder	3E-4	7E-4	7E-3
D Child	2E-4	4E-4	na

Note: Risks calculated for the arithmetic mean of external gamma radiation data from the Brown Vanderver and Desiderlo sites (all site data combined) continue to exhibit risks in the  $10^{-4}$  range for the 2-year exposure period.

### Soil Ingestion Exposures

Eqn:  $C \times IR \times CF \times EF \times ED \times SF = \text{Risk}$

C - Concentration (pCi/g)

IR - Ingestion rate (mg soil/day)

CF - Conversion factor ( $10^{-3}$  g/mg soil)

EF - Exposure frequency (d/yr)

ED - Exposure duration (yrs)

SF - Ingestion slope factor ( $\text{pCi}^{-1}$ )

Radionuclide	Slope Factor <sup>1</sup>
R-226 + Daughters	1.0E-9 <sup>a</sup>
U-233/234	1.4E-10
U-235	1.3E-10
U-238	1.3E-10

<sup>1</sup>EPA Health Effects Assessment Summary Tables (1/91)

<sup>a</sup>EPA Risk Assessment Guidance for Superfund, Vol 1 Pt B (1991)

### Soil ingestion exposure scenarios and assumptions:

Adult: 100 mg/day soil ingestion rate (RAGS, 1989)  
365 d/yr exposure frequency  
2, 5 and 70 year exposure duration

Child: 200 mg/day soil ingestion rate (RAGS, 1989)  
365 d/yr exposure frequency  
2 and 5 year exposure duration

## Navajo Bluewater site

### Soil Ingestion Risks:

<b>B-V Site:</b>	Adult Risks			Child Risks	
	2-year	5-year	70-year <sup>1</sup>	2-year	5-year
Ra-226	3E-5	7E-5	1E-3	6E-5	1E-4
U-233/234	3E-6	8E-6	1E-4	7E-6	2E-5
U-235	2E-7	6E-7	8E-6	5E-7	1E-6
<u>U-238</u>	<u>4E-6</u>	<u>9E-6</u>	<u>1E-4</u>	<u>7E-6</u>	<u>2E-5</u>
<b>Total</b>	<b>4E-5</b>	<b>9E-5</b>	<b>1E-3</b>	<b>7E-5</b>	<b>1E-4</b>

<sup>1</sup>70 year exposure assumes 65 years adult soil ingestion rate and 5 years child ingestion rate

<b>Des Site:</b>	Adult Risks			Child Risks	
	2-year	5-year	70-year <sup>1</sup>	2-year	5-year
Ra-226	2E-6	6E-6	9E-5	5E-6	1E-5
U-233/234	2E-7	4E-7	7E-6	3E-7	9E-7
U-235	7E-9	2E-8	2E-7	1E-8	3E-8
<u>U-238</u>	<u>2E-7</u>	<u>4E-7</u>	<u>6E-6</u>	<u>3E-7</u>	<u>8E-7</u>
<b>Total</b>	<b>2E-6</b>	<b>7E-6</b>	<b>1E-4</b>	<b>6E-6</b>	<b>1E-5</b>

<sup>1</sup>70-year exposure assumes 65 years adult soil ingestion rate and 5 years child ingestion rate

### Inhalation Risk Estimates - Radon Flux from Piles

The following risk estimates were provided by Barry Parks (EPA ORP, Las Vegas, NV.). Due to the uncertainties in estimating the source term, non-uniform distribution of the source term and limitations of the gaussian plume equation used in the CAP-88 software, risks are presented as **order-of-magnitude estimates** only. The risks are modeled for receptors present 100 meters from the center of the source (the nearest distance to the source which is appropriate for the gaussian plume model). Since residents at the site are frequently much closer to the piles than 50-100 meters, ambient air sampling for radon in the area of the mine wastes is recommended to more completely assess risks via this pathway.

Model Input: Source area	10,000 square meters (source radius ~56 meters)
Source term	100 Ci/yr
Meteorological	Grants, NM weather data

<u>Receptor Location</u>	Risk Summary	
	2-year	70-year
<b>100 meters SE*</b>	<b>2E-4</b>	<b>8E-3</b>
100 meters NE	4E-5	1E-3

\*Location of maximally exposed individual based on meteorological data

If you have question or comments regarding this memo I may be reached at  
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